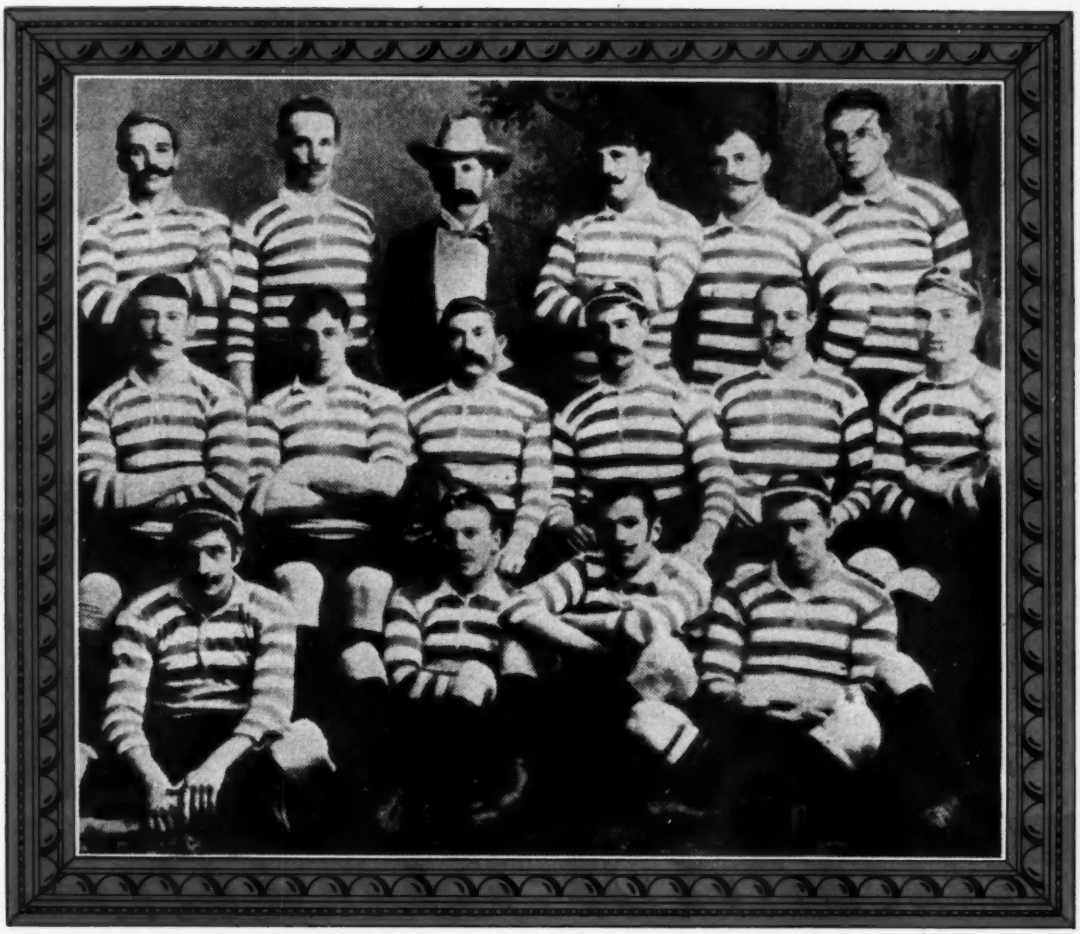
AUGUST 3, 1960

GAS IN INDUSTRY

Supplement to the "GAS JOURNAL"

Vol. 3 No. 27



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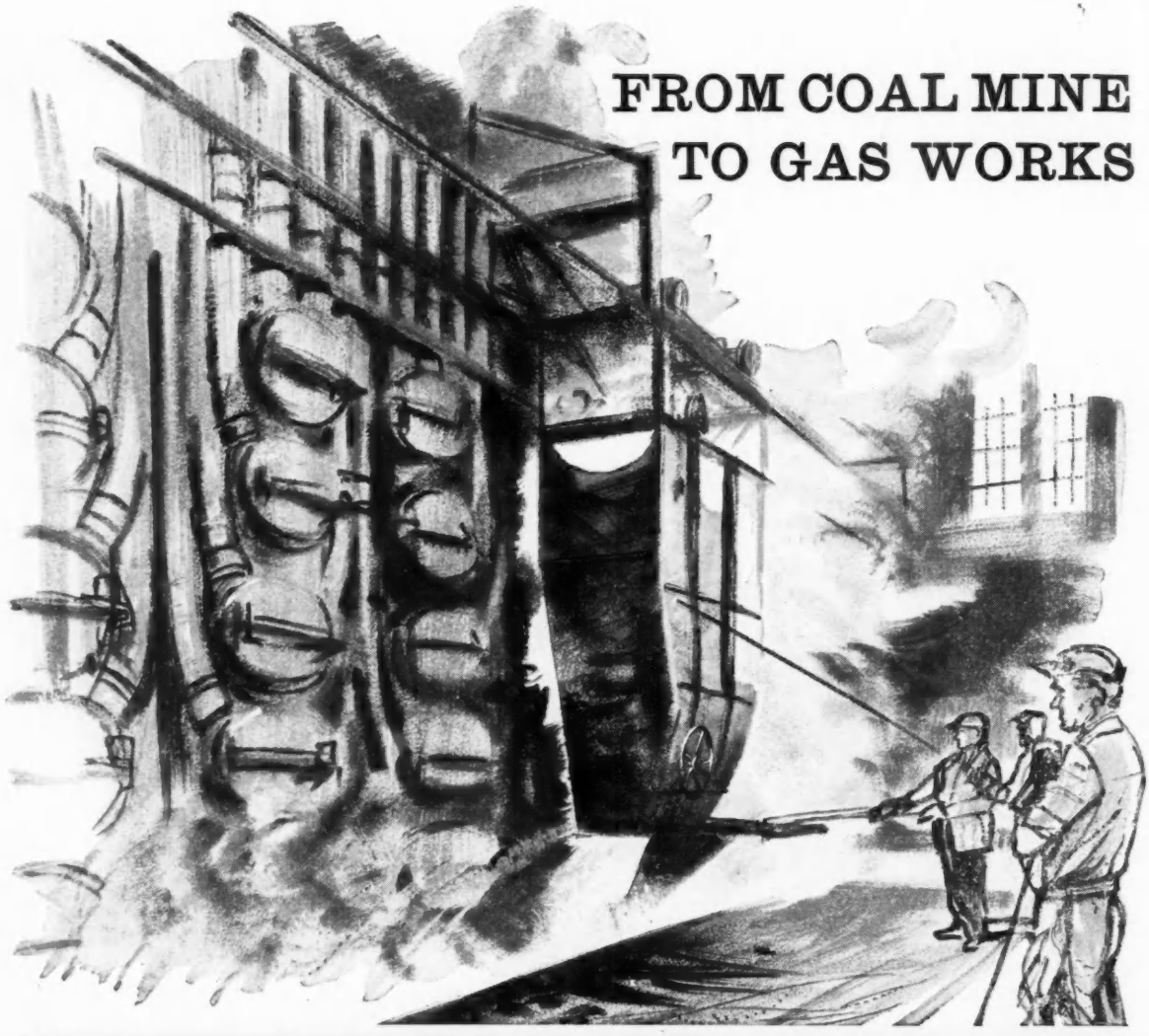

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GAS IN INDUSTRY

AUGUST 1960

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FEATURES

SCOTLAND'S INDUSTRIAL GAS—A FURTHER INSTALMENT OF THE ARTICLE BY

A. Higgs and A. R. Dean.

H. P. LUPTON'S TREATISE ON INDUSTRIAL GAS ENGINEERING.

Review by Dr. H. Alex. Fells.

SERVICING INDUSTRIAL CATERING EQUIPMENT—THE FOURTH OF A NEW SERIES ON INDUSTRIAL CANTEENS.

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Editorial

North Western Exhibition

THE North Western Gas Board's exhibition at 15, Whitworth Street West in Manchester should provide interest for all industrialists concerned with metal finishing. The application of gas firing to equipment of this type is important, since the conditions under which the work is carried out need the finest possible control of temperature, and for this a gaseous heating medium is particularly well suited.

Visits to exhibitions are the surest way of seeing what is new and especially the most up-to-date equipment applicable to any given industry. The gas industry is well aware of this, so it was not surprising that three gas boards in the south of England should have staged a 'gas in industry' exhibition in London early this year, to be followed by a similar display at Leeds shortly afterwards, sponsored jointly by the Northern and North Eastern Boards. By taking the exhibitions into the industrial areas, individual specialised equipment, applicable to those areas, can be put on view, with the result that industrialists can see for themselves the way in which advances, made possible by modern fuels, may be fully exploited.

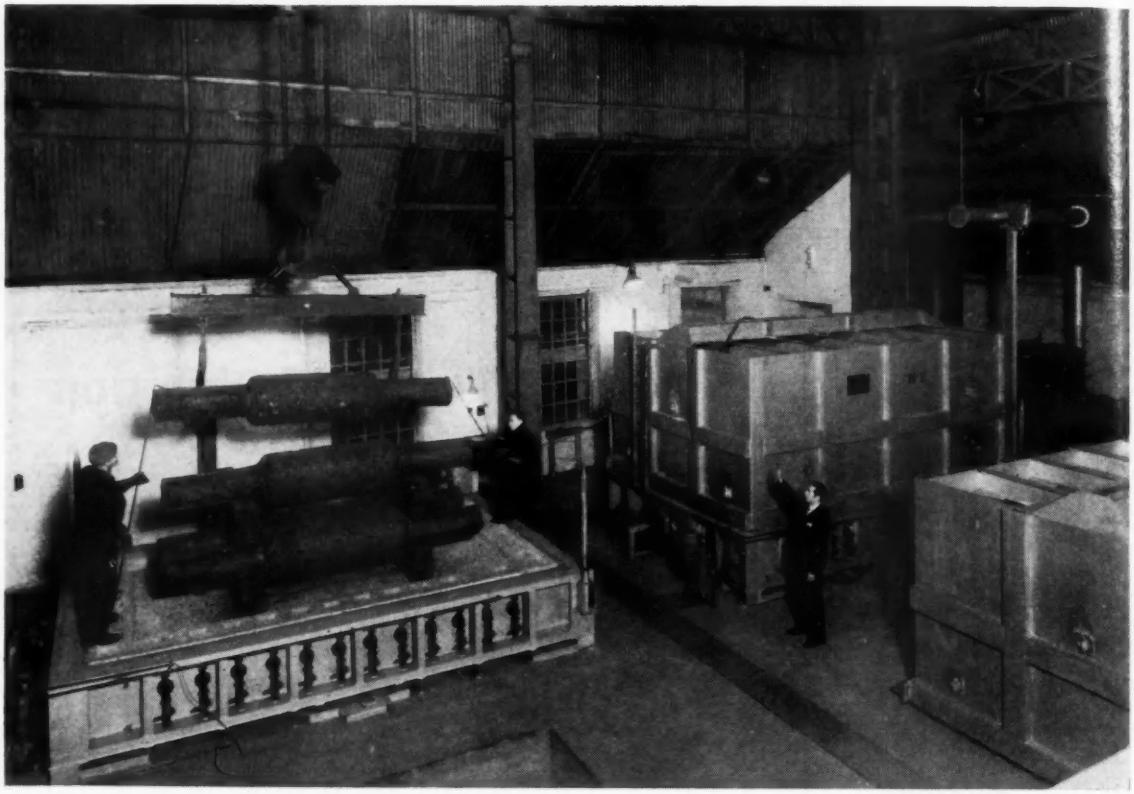
The present exhibition has attempted to show how wide is the range of articles to which the gas-fired furnace can be applied, and among those on view are elegant hair driers, printed beer bottle tops and heavy-duty nylon-lined bearings for engineering purposes.

The tendency in recent years to use reinforced plastic equipment by which the strength and rigidity of the metal base can be combined with the non-corrosive properties of the plastic covering, has made possible completely new ideas in the design of many household goods. The manufacture of plastic-coated plate racks is an example of this, so also are refrigerator shelves and car steering wheels. The wire or metal frame, preheated by gas, is dipped into a fluidised bath of 'gently billowing' polythene which fuses uniformly over the whole surface.

The development of the heating of liquids by gas-fired immersion tubes is a great improvement over the more orthodox bottom-heated tank. This particular appliance can be used with success in garages for degreasing engine components, the heating of plating baths and in rust proofing and metal colouring processes.

Gas applied to drying offers great scope for mechanisation and automation. Infra-red equipment fired by gas can speed up drying and other types of finishing, and is particularly well adapted for overhead conveyor lines to carry the articles slowly through the tunnel.

These examples give some indication of the gas-fired equipment on view at the exhibition. They show quite clearly that each must be designed for its own special purpose. Though the underlying principle may be common to a number of furnaces, each individual application must be carefully studied. The special requirements of the industrialist, the conditions in his particular factory and the kind of general scheme into which the new plant must be fitted, are all taken into account by the boards' industrial gas engineers, who must be, and indeed are, thoroughly conversant with the businesses and industry being carried on in their particular board's area. The exhibition will remain open until August 19.



By courtesy of William Beardmore and Co., Ltd.

Dowson and Mason portable-cover stress-relieving furnaces.

Scotland's industrial gas—II

By

A. HIGGS

M.Inst.Gas E., M.Inst.F.

Area Industrial Gas Sales Development Officer

&

R. W. DEANS

B. Sc., Assoc. M. Inst. Gas E.

Divisional Industrial Gas Sales Officer (Glasgow and Western)

THERE are many other gas applications in this extensive factory, which have been in use for a number of years. Six Dowson and Mason portable-cover furnaces 15 ft. by 8 ft. by 6 ft. are used for the stress relieving of castings, and eight bogie hearth furnaces 20 ft. by 10 ft. by 4 ft. for general heat treatment; also, forge furnaces converted from producer gas; gas-fired ladle-heating equipment in the extensive foundry, etc.

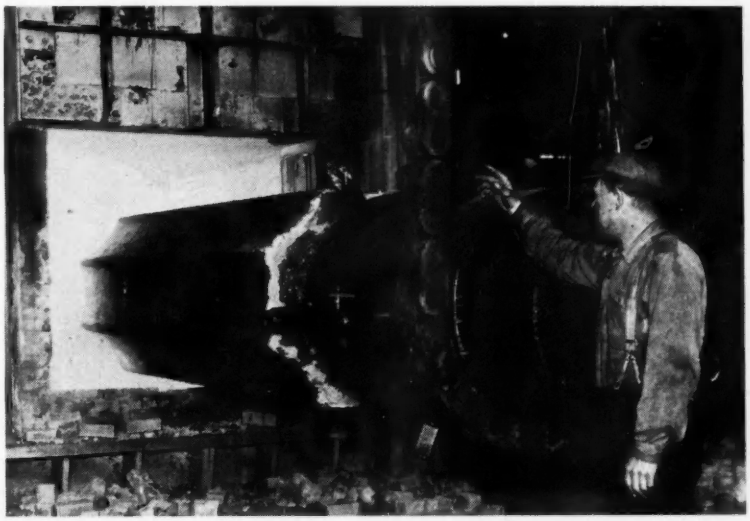
The Dennystown Forge Co., Ltd., is a very old-established firm, located in Dumbarton, which has for many years produced high quality finished forgings in considerable varieties, including turbine forgings, hollow shafting and all classes of engine forgings, mainly for the shipbuilding industry. Until recently, the company utilised solid-fuel-fired furnaces for heating ingots and for subsequent heat treatment of the forgings, but a number of these have been replaced with gas-fired furnaces.

Fig. 5 shows a Gibbons furnace having internal dimensions of 12 ft. deep by 9 ft. 9 in. wide by 8 ft. 3 in. high from sill to top of furnace chamber, for heating ingots up to 32 tons in weight to forging temperature of 1,220° to 1,320°C. The normal procedure is to insert the ingot into the furnace at the beginning of the day-shift and to leave the furnace on automatic temperature control to bring the

ingot up to temperature. The ingot is then soaked for the remainder of the night so as to obtain uniformity of temperature throughout, and is ready for withdrawal, and working under a '2,000-ton' press, the following day at 6.30 a.m. Usually, it takes from 6 p.m. until about 1 a.m. for the furnace to regain temperature after insertion of the cold ingot, and from that time until 6.30 a.m. to 9 a.m. to soak the ingot throughout so that it is ready for 'working.'

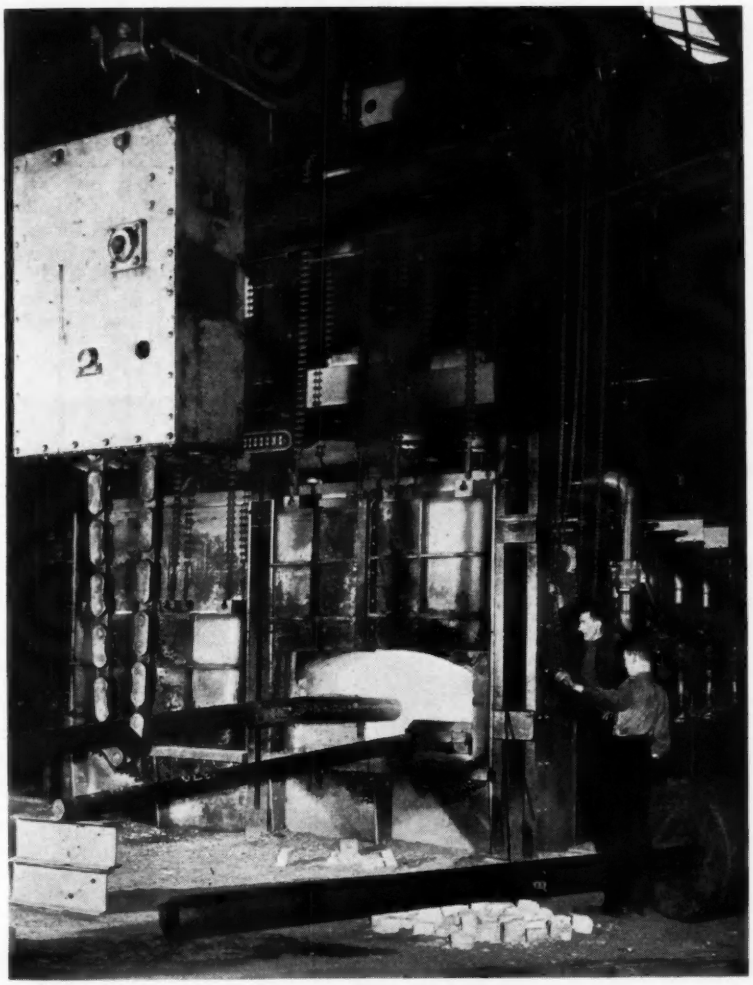
The furnace is fitted with Thermic Eddy Ray burners in each side wall, three burners being located on each side at low level, and three burners at high level so as to provide uniformity of temperature distribution. High/low temperature control is employed by means of motorised valves in the gas and air supply, operated from a Cambridge recorder controller.

Following charging, and the bricking up of the space on each side of the ingot below the door, the forging is left entirely on automatic temperature control without manual adjustment in any way. A slight pressure is always maintained at hearth level by virtue of the stack draught being broken by means of an aperture provided in the base of the stack. This pressure is maintained irrespective of fuel input, thus preventing air infiltration and loss of efficiency by excess air, while scaling is, of course, minimised. A typical gas consumption for heating a 32-ton ingot to 1,220°C. is 190,000 cu.ft. at a calorific value of 450 B.t.u. per cu.ft.



By courtesy of the Dennystown Forge Co., Ltd.

FIG. 5. *Gibbons ingot-heating furnace.*

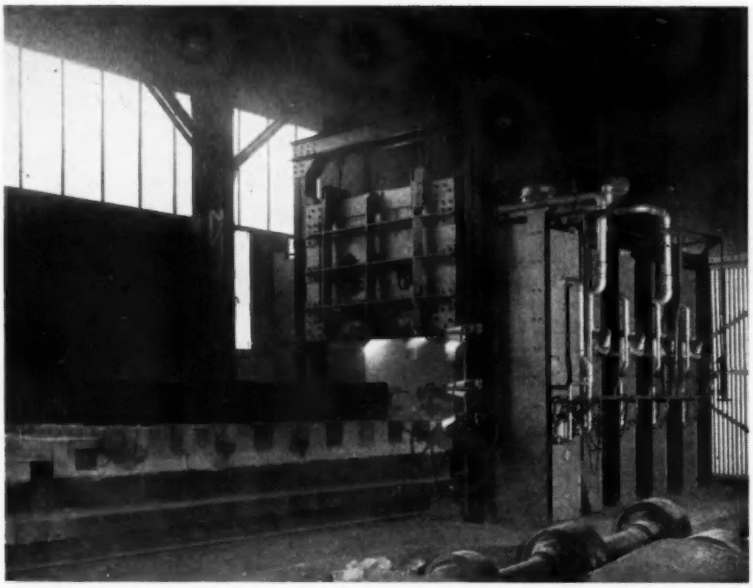


By courtesy of the Dennystown Forge Co., Ltd.

FIG. 6. *Gibbons billet-heating furnace.*

Fig. 6 shows a smaller Gibbons furnace, having internal dimensions of 9 ft. 6 in. deep by 13 ft. wide by 5 ft. high from sill to top of furnace chamber, for heating billets of up to 8½ tons weight. Four Thermic Eddy Ray burners are fitted in each of the side walls, and the furnace has double twin doors so that four separate forgings can be heated to forging temperature at the same time. Cambridge high/low temperature control is again employed by means of motorised valves in the gas and air supply lines. The waste gases from this furnace pass from the back of the furnace, and *via* a special flue, to a waste-heat boiler.

Fig. 7 shows a Gibbons bogie-type annealing and normalising furnace having internal dimensions of 16 ft. 6 in. deep by 7 ft. wide by 4 ft. 10 in. high from top of bogie to top of furnace chamber. This furnace was completed and came into operation in October, 1959, and is used for heat treatment in a range 600° to 950°C., and it controllable within ±5°C. Fitted in each side wall are six burners arranged to fire into combustion



By courtesy of the Dennystown Forge Co. Ltd.

FIG. 7. *Gibbons bogie hearth furnace.*

chambers in the bogie hearth in staggered formation, and five burners at high level are set at an angle towards the centre-line of the main arch.

The outlet flues are located immediately inside the door, and the waste gases travel up into top flues running lengthwise at each side, and thence into a back flue leading to the chimney. The air for the top burners, which consume the bulk of the fuel when operating at the higher temperature level, is preheated by a recuperator embodied in the waste-gas flues in the top of the furnace.

The gas consumption averages 2.9 cu.ft. per lb. when annealing forgings at 930°C. over a 12-hour cycle, and the annual gas consumption in a full year from all the new furnace plant should be 60 mill. cu.ft.

R. B. Tennent, Ltd., of Coatbridge, Lanarkshire, are producers of high quality cast steel rolls, weighing up to 50 tons. Individual rolls are expensive items in the finished state, so that failures due to faulty heat treatment are a matter of serious concern. Precision heat treatment is, therefore, essential, and this company are most insistent that the tolerances it lays down in respect of temperature distribution and temperature rise should be closely followed. For the precision heat treatment of rolls at temperatures up to 650°F., a Dowson and Mason portable-cover furnace is employed.

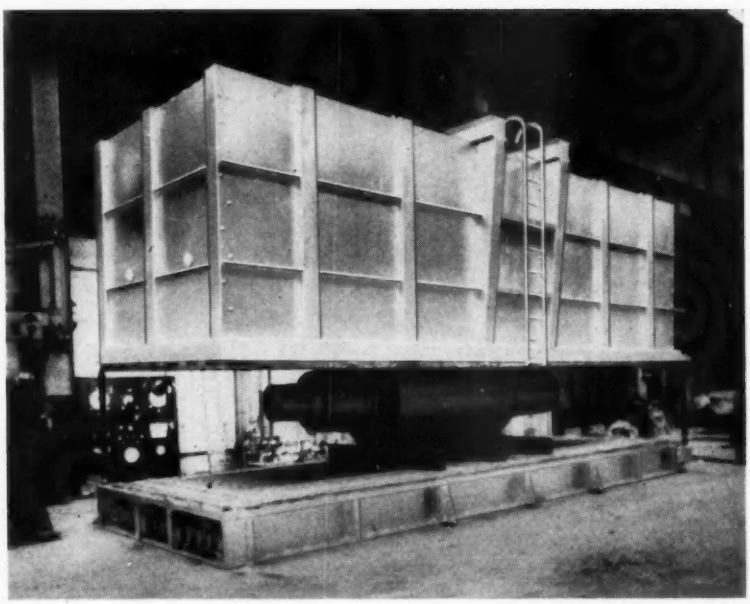
Fig. 8 illustrates this furnace, which is 28 ft. long by 7 ft. wide by 7 ft. high and employs high velocity forced-convection, involving two Peacock hot gas recirculating fans rated at 50,000 cu.ft. a minute each, against a resistance head of 2 in. w.g., to recirculate the gases throughout the working space at high velocity.

The gas burner equipment comprises two Dowson and Mason 'target'-type air-blast burner assemblies fed with air from a separate combustion-air blowing fan at 1 p.s.i., combustion taking place in two separate refractory-lined combustion chambers. The furnace is fully instrumented, electronic flame-failure equipment being fitted on the burner equipment. The wiring of the flame-failure amplifiers is arranged so that the two sets are paralleled up, this precaution ensuring that the plant shuts down if either burner fails.

Spark ignition is incorporated to the air-blast pilot on each of the main gas burners. Air:gas ratio control is provided by means of square port valves fitted in the gas and air supply to each main burner. Honeywell Brown temperature/programme controllers give proportional control, and the output from these controllers is arranged to operate two Hagen power cylinders fitted to the respective square port valves. The furnace is capable of being accurately controlled to give a temperature rise of the order of 10°C per hour with a differential of temperature within the furnace, when heat treating a 70-ton cast steel roll, of not more than $\pm 2\frac{1}{2}$°C.

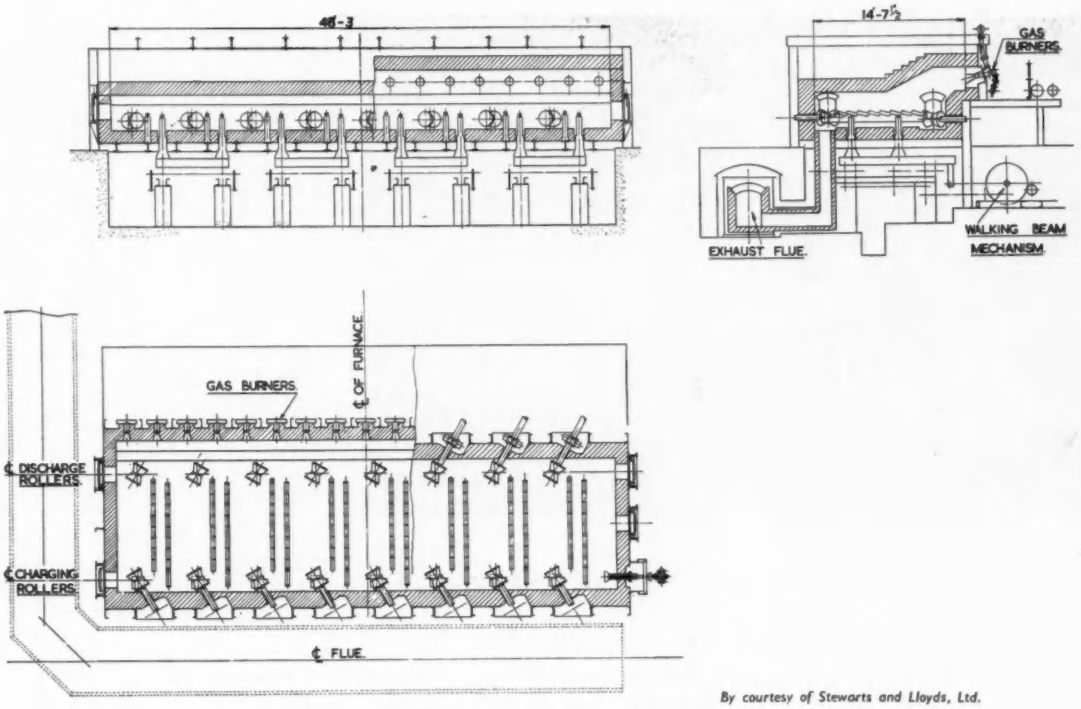
The overall gas consumption on a typical cycle, which would involve bringing a roll from room temperature to 550°C over 45 hours with subsequent long-cycle soak, would be 135,000 cu.ft. of gas for a 70-ton load.

For heat treatment at temperatures to 1,050°C, a Mathison multi-zone gas-fired bogie hearth furnace is employed. This furnace, capable of taking loads of up to 100 tons, is 30 ft. deep by 10 ft. wide by 8 ft. high. Longitudinally, it is divided into three zones for automatic temperature control purposes, the manifolds serving these zones being fitted with special 'Mathison' valves to give air:gas ratio control over the working range.



By courtesy of R. B. Tennent, Ltd.

FIG. 8. *Dowson and Mason forced convection portable-cover furnace.*



By courtesy of Stewarts and Lloyds, Ltd.

FIG. 9. *Priest tube-heating furnace.*

Nine vertical-firing luminous-flame-type burners are fitted on each side of the furnace. 'Foster' instruments are employed to give adjustable programme/temperature control, and the temperature rise can be controlled so as to not exceed 10°C per hour. Provision is included in the furnace for a measure of recirculation of the gases in the early stages, *i.e.*, at the lower temperatures. Recuperation is also provided for by a metal heat exchanger incorporated in the flue offtakes.

The maximum gas consumption of the furnace is 14,000 cu.ft per hour. It is difficult to give performance data as the heat-treatment cycles, and loadings, vary appreciably and involve periods of time of up to 21 days.

The usual safeguards are provided by way of air fan failure and low gas pressure protection, manual resetting being essential after close-down.

The annual gas consumption of these two furnaces is approximately 30 mill. cu.ft. A third furnace is under construction and further furnaces are projected.

Fig. 9 shows a cross-section of an unusual design of normalising furnace at present under construction by Priest Furnaces Ltd., at the Clydesdale works of Stewarts and Lloyds, Ltd. Special attention has been paid to the problem of progressing the tubes through the furnace, as tubes bow very rapidly if unevenly heated. The furnace is 48 ft. 3 in. wide by 14 ft. 7½ in. long, measured inside the brickwork.

A tube enters the furnace on skewed rollers and is thus rotated whilst being moved forward until its leading end touches a stopper, which stops the charging rolls and actuates the walking-beam, which lifts the tube from the rolls. The tube is then walked and slowly rotated across the furnace to the discharge rollers, which are also skewed. The rotation of the tube throughout its travel is aimed at obtaining uniformity of temperature.

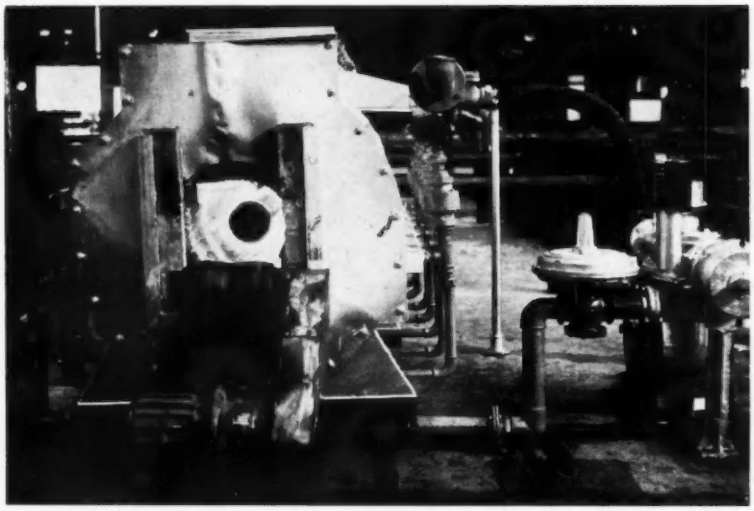
The design capacity of the furnace is 5 tons per hour, but 7 tons per hour will be possible on favourable sizes. The tubes are heated from cold to 950°C. The combustion equipment consists of 17 tunnel gas burners applied through the discharge end wall. These burners are divided into two groups of six burners and one of five burners, forming three zones to each of which fully floating temperature control equipment is applied together with air : gas ratio control. A recuperator is installed in the flue system and furnace pressure control has also been applied.

Fig. 10 illustrates a radiant tunnel furnace for accelerating the drying of paint on tubes. Three such furnaces, manufactured by Radiant Heating, Ltd., London, are in service. Six No. 4 type radiant combustors, supplied with a gas and air mixture from a premix plant, are fitted in each of the side walls and arranged to fire tangentially around the tubes as they pass through the furnace, which is 8 ft. long and of 12 in. diameter.

The maximum furnace temperature is of the order of 1,450°C, and the tubes, which enter the furnace on rollers and pass through at a speed of 60 ft. per minute, are preheated to approximately 125°C. Paint is then applied to the tube, and the pre-heating of the steel speeds drying. The heating of the tubes prior to drying has eliminated bottle-necks in production. The average fuel consumption of each furnace operating at 1,180°C. is 2,300 cu.ft. per hour when dealing with ⅜-in. wall tube, 6 in. in diameter, at 60 ft. per minute. These installations should in a full year consume approximately 100 mill. cu.ft.

These installations are representative of modern plant being installed in Scottish industry, and many major schemes, involving plant incorporating notable technical advances in thermal engineering, are going forward, or are under consideration. In total, new furnace plant at present on order will take an additional 1,500 mill. cu.ft. per annum of gas by 1962.

It is conceded that a short path to increased industrial gas sales lies in the conversion of process plant from other fuels, and, in Scotland, there is



By courtesy of Stewarts and Lloyds, Ltd.

FIG. 10. *Radiant Heating, Ltd., combustor furnace for tube heating.*

appreciable potential of this nature to be exploited. Existing process plant may represent considerable capital outlay not yet written off, and the question of entire plant replacement may not warrant consideration for a period of years.

Where such plants can be converted at reasonable capital outlay, preferably recoverable from savings to be achieved, business may be secured by the submission of designs and proposals for conversion. Where savings in running costs combine with the advantages of town gas, the case is usually strong, but, with equivalent costs, the production advantages may still determine the issue in favour of conversion.

During the last 12 months, the Board's industrial drawing office produced 111 drawings, covering conversion of process plant, the construction of prototype equipment, and also control layouts for industrial and commercial installations.

The availability of a sound and comprehensive technical advisory service is undoubtedly a major factor of the development of industrial load.

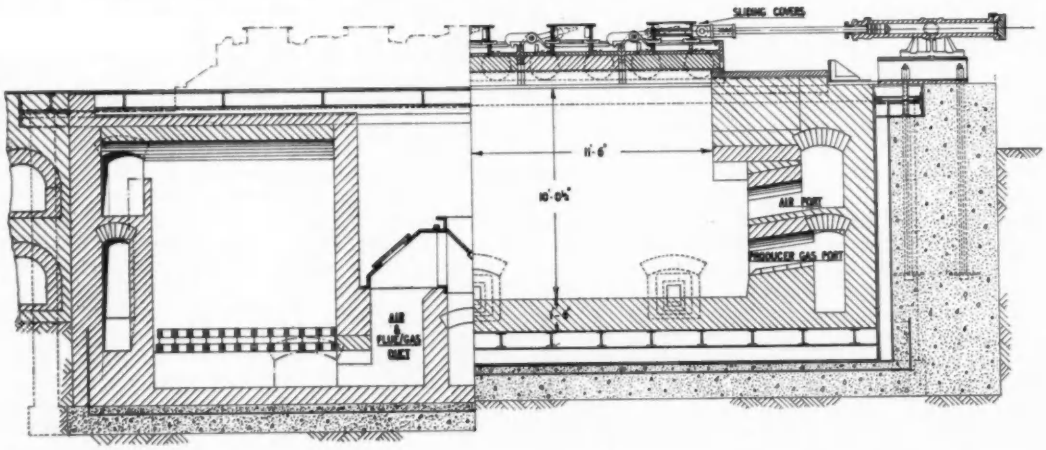
Beardmore and Co., Ltd., has for many years used producer gas as a medium for heating two soaking pits in a cogging mill. A scheme was submitted for conversion, and, after considerable discussion and amendment, was accepted, provided that the conversion of the soaking pits to town gas firing could be completed during the first two weeks in January, 1960.

The two soaking pits are 26 ft. long by 11 ft. deep by 7 ft. wide, and can deal with an output of 4 tons per hour of steel soaked at 1,230° to 1,250°C. The furnaces were installed before the second world war, and the design allowed of regeneration of both the producer gas and the combustion air. Changeover of the regenerators was manual and not synchronised, the operating levers being located at floor level.

Fig. 11 shows a section through the soaking pits as they existed, and it will be noted that the producer gas was fed in through the lower ports whilst the combustion air was induced, under stack draught, through the regenerator and the upper port. This arrangement gave a long slow-burning flame that filled the pit and contributed to the achievement of uniformity in temperature distribution. Fig. 12 shows the modifications made for conversion to town gas firing.

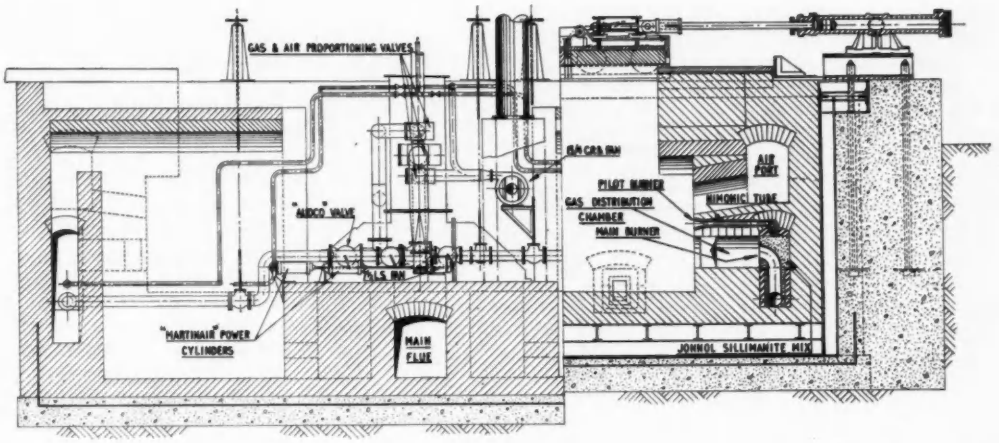
The producer gas regenerators were stripped out, together with the 24-in. changeover valve. The feed-in ducts for producer gas were used to give access for the introduction of the main burner and pilot supply pipes. All pipes in the ducts are encased in Durax for permanence. The entire pits were rebricked and heat losses were reduced by incorporating Selfrac insulating refractory behind the firebrick side walls and base. The covers were lined with Selfrac Plus insulating refractory.

Gas is introduced into the lower port by means of an 8-in. steel tube, calorised to minimise scaling. This is surrounded by Jonnol sillimanite ramming mixture, with the objective of providing a permanent sillimanite tube to give continued service as the steel tube deteriorates. The gas discharges into a diverging distributing chamber and then enters the furnace through ports positioned so as to give a 'spread' below the air port, which is sited as in the original design. For safety when at low temperatures (*i.e.*, during initial heating), pilot burners, formed in Nimonic steel tubing, are located between the air and the gas ports at each end. These tubes are



By courtesy of William Beardmore and Co., Ltd.

FIG. 11. *Design of producer gas-fired soaking pits.*



By courtesy of William Beardmore and Co. Ltd.

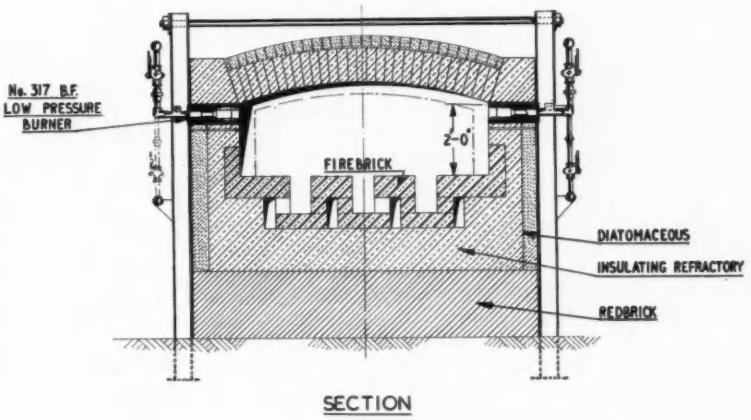
FIG. 12. *Design for conversion of soaking pits to town gas.*

again surrounded by a sillimanite ramming mixture for permanence.

The pits have been pressurised by the provision of air-blowing fans rated at 75,000 cu.ft. hour of air, at 3 in. w.g., which now feed the main air ports *via* the regenerators. In addition, smaller-capacity fans are provided with a rating of 15,000 cu.ft. per hour at 6 in. w.g., and these serve to feed the pilot burner, combustion air requirements, and also to provide a small percentage of the main burner combustion air as primary. The objective of providing approximately 10% of main burner air as primary is to avoid the possibility of carbon deposits building in the gas supply ports, as these are subjected to radiation from the pit at 1,230°C.

A new changeover valve system was installed on each pit, and this comprised two 8-in. Audco light-pattern valves linked on the main burner gas supplies and two 6-in. Audco light-pattern valves linked on the primary air supplies. The original 30-in. exhaust and the main combustion air changeover valve were retained on each pit. Changeover has, however, been sychronised and made semi-automatic by the fitting of Martonaire power cylinders to each set of valves and also to the main 30-in. changeover valve. These are operated by the soaking pit 'heater' by simply pressing a switch. A 10-minute cycle is followed after initial balancing of the regenerators.

Air : gas ratio control is achieved by means of Dowson and Mason adjustable square port valves, three such valves being bracketed together and fitted to each installation. The valves are linked to facilitate control by hand, or, in due course, by automatic temperature control. Six-in square port valves serve the gas and primary



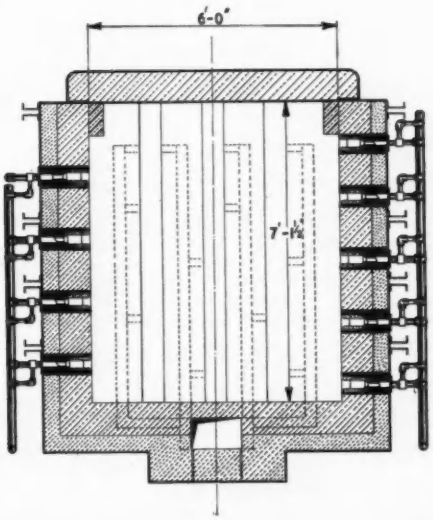
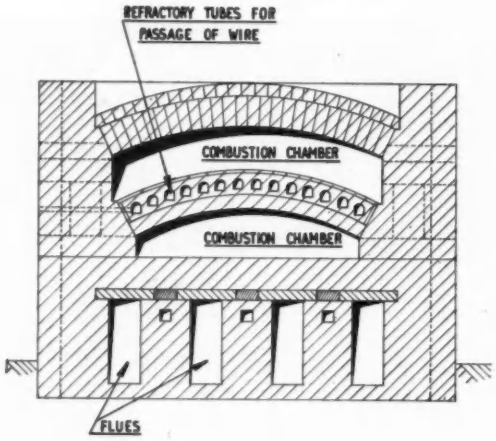


FIG. 13.—*Design for conversion of heat-treatment furnaces.*



By courtesy of Martin, Black and Co. Ltd.

FIG. 14. *Section through coal-fired furnace.*

air, and 10-in. square for the main combustion air.

Ancillary control equipment, to provide for fan and gas failure, and to ensure safe lighting, comprises a Jeavons 8-in. fan-failure valve with auxiliary gas valve. Separate governors are fitted on the main and pilot gas supplies. The pilot gas burners are served by 2-in. Keith Blackman air-blast injectors located in the general pit alongside the setting, and these feed 2-in. calorised steel 'mixture' tubes terminating, as mentioned, in Nimonic tubes where subjected to high temperatures. The calorised tube was supplied by the Calorising Corporation of Great Britain, Ltd.

In practice, the pits are full of flame, and the heat distribution is quite as good as that obtained with the slower-burning producer gas, while general control and operating conditions are very much improved.

The annual load accruing from this conversion will be approximately 200 mill. cu.ft.

A survey of producer and process plant in one works was carried out and the conclusion drawn that appreciable financial saving could be established in this instance by conversion to town gas firing.

Fig. 13 illustrates the design for conversion. Twelve furnaces of identical internal dimensions have been converted and operate in the temperature range from 700° to 1,250°C. Appropriate sizes of British Furnaces low-pressure-velocity burners are employed, the furnaces required to work to 1,250°C being lined with Selfrac Plus insulating refractory in the side walls and arch, and the others with standard Selfrac insulating refractory. Air is provided at a pressure of 1 p.s.i. to serve the burner system, one Peacock air-blowing fan being employed to serve a battery of three furnaces.

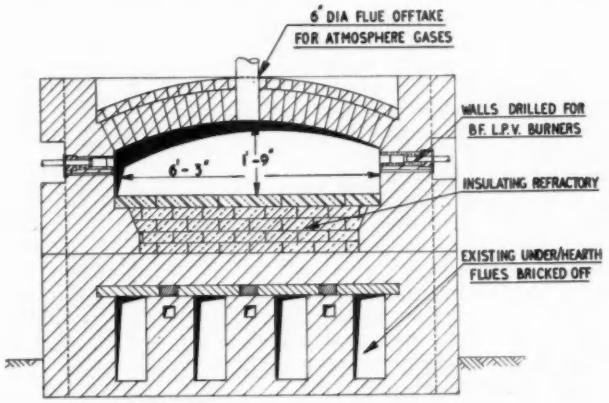
As designed, the furnaces are capable of heating a load of 2 tons of steel from cold to 900°C in 3 hours, including soaking time, whereas the producer-fired furnaces work to a maximum of 1¼ tons on a 4-hour cycle. The temperature distribution and accuracy of temperature control is very considerably improved with town gas, and the necessity to reheat has been greatly reduced. The cost per lb of steel heat treated, including all labour charges, is appreciably less, using town gas. The new business secured will account for 150 to 200 mill. cu.ft. of town gas in a full year.

Martin, Black and Co. Ltd., of Coatbridge, Lanarkshire, are producers of high quality mild and carbon steel wire for a variety of purposes. Until recently, this company employed coal firing on its No. 5 patenting furnace, which unit is 50 ft. long by 6 ft. wide by 18 in. to crown of arch. With coal firing, indirect heating with refractory tubes was necessary, the heat input being applied externally to the tubes and transmitted to the wire by conduction through the walls of the refractory tubes, and subsequently by radiation to the wire passing through on the inside. The output of wire was thus limited by the low rate of heat transmission imposed by the refractory walls. Fig. 14 shows the original design, and Fig. 15 the new design.

With the design for town gas, the muffle has been eliminated and the wire is now directly heated by means of a multiple burner system fitted in the side walls of the furnace. Eighteen British Furnaces air : gas proportioning low-pressure-velocity burners are fitted in each of the side walls and arranged in staggered formation, and the furnace is divided by separate manifolding into three 'zones' for temperature control purposes.

The rating of the burner systems in each of the 'zones' is related to the duty involved. The burners in the first 13 ft. long zone are sized so as to give a maximum rating of 5,000 cu.ft. per hour using air at 1 p.s.i. to heat the incoming cold load of 1 ton per hour of steel wire to 950°C. The next 13 ft. long zone is rated at 3,500 cu.ft. per hour to complete the heating demand, while the last zone, 26 ft. long, is arranged with burners having a maximum rating of 2,200 cu.ft. per hour, solely to hold the load at the required temperature of 950°C. The output of 1 ton per hour is in practice almost three times that possible with indirect coal firing.

The combustion products from the furnace are drawn off by a hot gas fan, *via* a connexion in the arch in the centre zone, and these combustion products provide the atmosphere requirement of a number of electrically heated furnaces and thereby eliminate the gas consumption pre-



By courtesy of Martin, Black and Co. Ltd.

FIG. 15. *Section through converted wire-patenting furnace.*

viously involved on separate atmosphere generators.

The furnace atmosphere in the converted furnace is set so as to give a concentration of carbon monoxide varying from .5 to 4%, depending on the wire being treated, and ready adjustment of the atmosphere is provided for by the provision of purge lines on each side of the furnace. The purge lines allow neat gas to be fed into the furnace through small heat-resisting tubes fitted at intervals along the entire length of the furnace.

Automatic temperature control is afforded by means of Ether 995 Transitrol proportioning controllers. These operate Selas adjustable square port valves by means of Ether self-balancing motors, and these are installed in each of the air lines feeding the various zones in the furnace. The gas consumption per ton of wire treated varies somewhat with throughput, but averages between 4,000 to 4,500 cu.ft. per ton. The additional business secured is 36 mill. cu.ft. per annum but the conversion may well influence other business.

Fig. 16 shows a design for the conversion from coke firing of a 17-ton galvanising bath used for continuous wire production and, to give good pot life, it is arranged with a heat input allowance per sq. ft. within the conventional allowance of 10,000 B.t.u. per sq.ft. per hour. The dimensions of the pot are 9 ft. long by 4 ft. wide by 2 ft. 6 in. deep. Fifteen drilled-bar burners, calorised to prevent scaling, are fitted around the pot at 19½-in. centres. Each individual burner is served by a 1½-in. Amal-type injector, the burner port area being arranged so that the flame is semi-luminous in character.

The flames burn vertically behind short firebrick baffle walls, the combustion products being drawn over the wall and down the sides of the bath. Graduated-flue gas ports are arranged between the piers supporting the bath to balance flue pull and secondary air entrainment, and the gases then pass into a main flue running under the centre of the bath.

The maximum gas rate of each burner is 155 cu.ft. per hour at 3 in. w.g., and the bath is capable of dealing with 1 ton per hour of wire with an average gas consumption of 1,800 cu.ft. The setting is substantially constructed of Selfrac insulating refractory, excepting the bath support piers.

Use has been made of the combustion products for the heating of a flux tank, and it will be noted from Fig. 16 that Marinite insulating board is fitted around the flux tank on a suitable iron frame, and that the combustion products from the galvanising bath can be exhausted *via* the flux tank, or direct, at will.

An ejector system is employed in preference to a hot gas fan, and air is supplied to the jet of the ejector from a small air-blowing fan rated at 16,000 cu.ft. per hour at 14 in. w.g. Graduated dampers are provided in the flue offtake pipe from the galvanising bath and the flux tank to enable the temperature of the latter to be controlled at 150°C. Provision is also made by the insertion of tees for further use of the waste gases for other low-temperature process work.

The temperature of the galvanising bath is accurately controlled at 450°C. by means of an Ether 995 temperature controller operating a 24-V self-balancing motor and 2-in. square port valve in the gas supply. The coke consumption of the original setting averaged 5½ tons per week, and while, on a fuel basis only, cost of gas is higher, the increased production and consistency of quality, and the elimination of manual and executive

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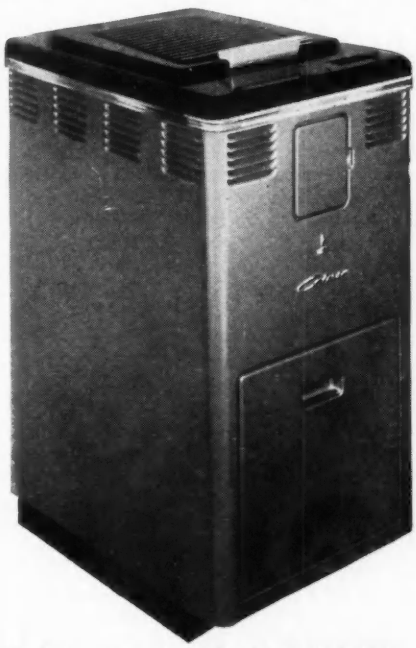

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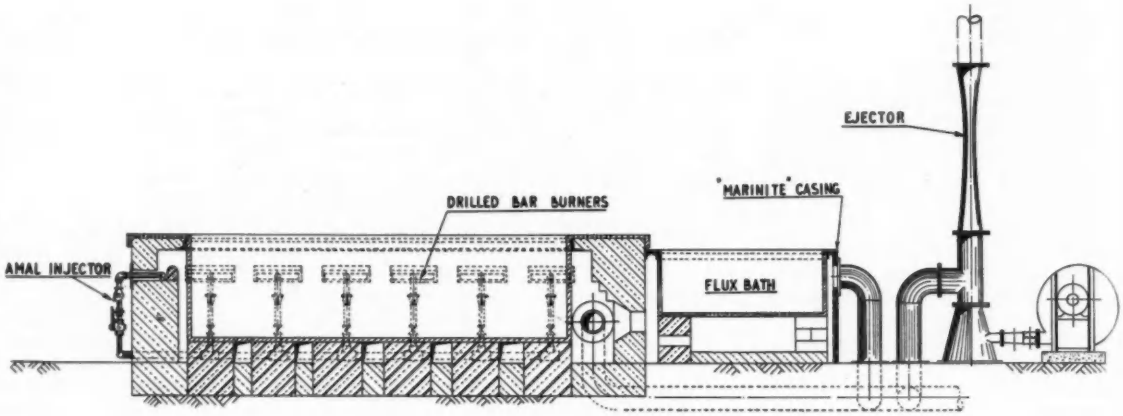

FIG. 16. *Design for conversion of 17-ton capacity galvanizing bath.*

supervision, have resulted in instructions being received for further conversions.

The annual load from each installation is approximately 18 mill. cu.ft.

Considerable quantities of gas are used in the production of die-castings, and attention was devoted to this load recently in order to counter the threat of loss on load to electric resistance heating. Tests were carried out on existing 350-lb. capacity aluminium bale-out furnaces at two works causing immediate concern.

In order to consolidate the load, an offer was made to both firms to design furnaces to improve efficiency and to install prototype on a 'sale or return' basis. These offers were accepted and a design was evolved as shown in Fig. 17*a*. Fig. 17 shows the original design.

The new design makes generous use of insulating refractory and employs a double casing through which the combustion air is passed. An air/gas proportioning burner is fitted. The reduced thermal capacity afforded by the insulating refractory lining, combined with the increased efficiency resulting from the control of air: gas ratio on the British Furnaces L.P.V. burner, in conjunction with automatic temperature control equipment, led to an overall saving in gas consumption of 40%.

The provision of the double casing, while preheating the combustion air to a temperature of the order of 80°C., was incorporated primarily to improve working conditions from the operative's standpoint. Pot life has also been improved, and both consumers concerned have arranged for further furnaces to be reconstructed to this design. The load consolidated approximates, on the multiple furnaces employed, to 25 mill. cu.ft. per annum.

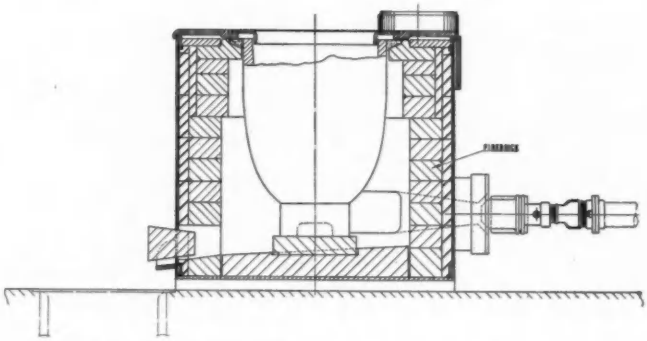

FIG. 17.—*Original design of bale-out furnace.*

A wire-manufacturing firm was interested in increasing the output from an electrical resistance-heated wire-patenting furnace. The furnace was 20 ft. long with a cross-section 2 ft. 3 in. wide by 9 in. high. Consideration was given to this problem, and a gas-fired extension was added to the front of the electrically heated furnace, as shown in Fig. 18.

This extension has internal dimensions of 7 ft. long by 2 ft. 3 in. by 12 in. high to spring of arch, and is fitted with eight air-blast burners arranged in staggered formation in the side walls. Four No. 314 British Furnaces burners, rated at 340 cu.ft. per hour each, are fitted near the intake, end, and four No. 212 burners, rated at 225 cu.ft. per hour, between these and the entrance to the electrical furnace. This gives an overall gas consumption of 2,260 cu.ft. per hour, with air at 1 p.s.i. Temperature control of this section is again by an Ether 995 Transitrol proportioning controller operating a self-balancing motor, and a 4-in. Selas square-port valve fitted in the air supply line. Zero gas pressure governors serve the burner system, but a 3-in. constant-pressure governor is also fitted in the gas line.

With the maximum gas rating, the output from the furnace has been increased from 7 cwt. to 15 cwt. per hour, and the electric heat input has been reduced from390 kW to 234 kW. Previously, separate atmosphere generators were also employed, but the fitting of the gas booster section has eliminated the need for separate atmosphere generation, and the combustion products from the gas section are fed through the electrical furnace. A slightly reducing atmosphere, with about 1% of carbon monoxide, is maintained.

The annual load in a full year should approximate to 17 mill. cu.ft.

Fig. 19 shows the design adopted for the conversion of a 'slug'-heating furnace. This serves for the heating of steel rounds, mainly 6 in. by 1 in., used in the manufacture of chain links.

The furnace is 8 ft. long with a section 12 in. by 12 in., and was formerly fired by fuel oil. The 'slugs' are 'end-on' and are traversed by a multiple pusher, *via* V-slots in the hearth, to the main heating zone in counter-flow to the outgoing waste gases.

To be continued

BOOK REVIEW

H. P. LUPTON'S NEW TREATISE ON INDUSTRIAL GAS ENGINEERING

By Dr. H. Alex. Fells,

M.B.E., B.Sc., F.R.I.C., F.Inst.F., M.Inst.Gas E.

A GOOD industrial gas engineer needs to be well trained in combustion engineering and chemistry and must be capable of applying his thoughts to almost any problem requiring the use of heat. He must be capable of applying his technical skill and understanding, and to do this considerable mental elasticity and adaptability are essential.

Such a man of course does not 'just happen'; he has to be trained and naturally a large part of that training consists in assimilating technical information. Adequate technical information has been available for many years, 'hidden in the mass of technical literature,' as is stated in the preface to *Industrial Gas Engineering*,* and it is a matter for commendation that Mr. H. P. Lupton has collected so much of this information into one book.

Three volumes

The book is published in three volumes; Volume 1 under the broad title of 'General'; Volume 2 under the title of 'Commercial' and Volume 3 under the title of 'Industrial.'

Volume 1—'General,' is concerned with such initially essential matters as 'The properties of town gas,' 'Gas laws-flow-load-factor,' 'heat transfer,' 'combustion characteristics,' 'industrial combustion equipment,' 'control of combustion,' and technically-related subjects such as 'furnace design.' Each chapter deals in detail with those factors essential to good theoretical appraisement, makes adequate use of illustrations, tables, examples and necessary equations for calculations and at the same time gives the whole subject a most substantial practical outlook.

This volume constitutes the basis for an industrial gas engineer's training in combustion engineering, and as such will prove to be one of the most useful factors in the early training for the type of man a good industrial gas engineer has to be.

Volume 2—'Commercial,' is concerned with 'space heating,' 'water heating,' 'catering-kitchen-planning and equipment,' 'laundering,' 'incineration' and 'cremation,' and naturally more than a half of the contents deal with two of the gas industry's major commercial uses of gas—space heating and water heating.

These sections are particularly commendable in that they give in such concise form a splendid balance between the theoretical and practical approach to complex problems of heating. Again valuable use is made of diagrams, illustrations, charts, tables and examples in amplification of the method of calculation required for the several purposes. The other sections, catering and kitchens, laundering, incineration and cremation are severely practical, as they should be, and indicate the mental elasticity and adaptability required of an industrial gas engineer.

Benefit to new engineers

Volume 3—'Industrial,' deals with those industrial applications of gas where the industrial gas engineer really comes into his own. This is where he can make the fullest use of his technical skill, his thought, his mental elasticity, understanding and his adaptability. The reviewer feels sure that Mr. Lupton gained great satisfaction in preparing this third volume, based on his long and wide experience, knowing that very many new industrial gas engineers and even older ones, would benefit greatly from such a recording. He summarises this neatly in the second paragraph of the preface to the whole book. This third volume is concerned with the use of heat in the metals industries, the ceramics and glass industries, vitreous enamelling, plastics and rubber, paints and varnishes, textile finishing, core and mould drying, timber drying, food preparation, steam raising, and in that splendid generalisation—miscellaneous heating processes.

As is necessary, each section deals with those basic requirements of the industry without which a proper appreciation of the use of heat could not be made, and the value of gas as a heating medium in the widest sense is made obvious.

Wide knowledge

The sections on metal heating and glass processing particularly indicate the wideness of the knowledge required by the industrial gas engineer, and it is so very useful that he can have this information between the covers of one book.

Mr. Lupton will make no claim that his book is fully comprehensive or that it has no inaccuracies. Indeed, he says so in his preface, but it can be said that the whole book summarises a vast accumulation of long and varied experience in the use of town gas as a heating medium and presents this in a manner which commends it to both student and teacher alike as well as to the engineer who wishes to have the means of quick application to any new heating problem.

Not only Mr. Lupton, but also the sponsors of the book have done signal service to the gas industry in its endeavour to produce the type of good industrial gas engineer described in the opening paragraph of this review.

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* *Industrial Gas Engineering*, H. P. Lupton. In 3 volumes; 856 pp., 220 diagrams and plates, 93 tables. Published for the North Western Gas Board by Walter King Ltd., 11, Bolt Court, Fleet Street, London, E.C.4. £10 per set G.B. Overseas $29 or draft on London.

FACTORY KITCHENS — IV

By 'GAStronome'

Servicing industrial catering equipment

IT will perhaps be obvious to industrial managers that equipment correctly and methodically serviced pays dividends through easier operation and prolonged life. But to what extent should servicing be carried out, at what intervals and by whom?

Servicing arrangements fall under three headings:

1. The daily and weekly cleaning by the kitchen staff.
2. The contract servicing at regular intervals by the manufacturer and gas board.
3. The cleaning at regular intervals by a contractor who can carry out this operation at a more advanced stage than the kitchen staff.

A kitchen recently described in 'Gas in Industry' will serve as an example for a maintenance schedule. It is meant to cook and serve 250 midday meals and contains the following equipment:

A four-oven cooking range with bain marie.
A steaming oven.
A deep fat frying unit.
A 12-ft. run of hot cupboards.
A water boiler with coffee and milk urns.
A grill salamander.
A dish washing unit.
A potato peeling machine.
A general purpose mixing machine.
A power-driven meat slicer.
A bread slicer.
A chipping and slicing machine.
One or two waste disposal units.
A refrigerator.

First of all we will deal with the gas heating equipment.

Extensive usage

Cooking equipment burning gas is likely to be used on 250 days in every year, for about two to three hours a day. Such extensive usage justifies a check-over of gas rates, flame adjustment, ventilation, combustion and cooking performance, together with examination of the control taps and thermostats and any wearable parts like top bars and shelf runners, ball valves and water levels, at least three to four times a year. Such checks should be carried out at regular intervals.

The equipment in this staff restaurant kitchen is cleaned daily and adequately serviced—it has been in operation for over three years.

This work can best be carried out either by the manufacturer of the equipment or the area gas board. When most of the equipment is of one make it may be convenient to contract with maker for this service. The advantage is that the engineer is workshop trained and is, therefore, a specialist; he will also be able to obtain any replacement parts immediately and may be able to renovate parts on the premises or at his workshops.

Most manufacturers will undertake to carry out this work on a contract basis and will even give special estimates for work done out of normal hours. In many cases they are prepared to include items of other manufacturers provided these do not outnumber their own.

Different manufacturers

Frequently one manufacturer supplies all the cooking and food service equipment, but a competitor supplies the water boiling machine and the dish washing unit; servicing may be carried out by the former company which sends in one account.

Servicing contracts can usually be concluded with the local gas boards who are fully equipped these days to maintain large-scale cooking and food service appliances; however, they are not normally able to provide all replacement parts from their stocks. Happily, replacements can be obtained at very short notice and it is only necessary for the area board to ensure that they are available.

Cleaning not included

Service agreements with manufacturers and gas boards do not normally include the degreasing and cleaning of equipment, neither is it likely that it can be arranged by them as they are so often inundated with maintenance work. There are organisations which specialise in the complete cleaning of equipment, working on a contract basis and at times that suit the catering management. Cleaning could be carried out at the same time as servicing, but where the kitchen staff work reasonably well, this should only be necessary once a year.

Records useful

It is important to have complete records of what has been done, when

it was done and by whom. It is also useful to note deterioration or defects that require attention for the next time the service engineer calls. These should be entered into a log book with details of all the kitchen equipment and it is best to keep this book in the kitchen itself so that it is used as intended.

A simple but quite adequate heading in this log book could read as follows:

Description of equipment	Date last serviced	Date last cleaned	Special attention required at next visit	Name or 'phone No. of service contractor
4 oven range and and bain marie ..	8.5.60	2.2.60	Ease tap on front of No. 1 oven	Gas Board ALT 7013
Steaming ovens ..	8.5.60	2.2.60		— do. —

When more than one unit is used to made up a group, as is common with ranges and steaming ovens, each unit should be numbered and a key should be drawn on the front sheet of the log book.

Log-keeping essential

It is emphasised that keeping such a log is essential in any well-run commercial kitchen, for any lengthening of the intervals between servicing can cause marked deterioration in the performance of an appliance. Although it is true that gas equipment can go for long periods without servicing, nothing can be gained by putting it to this trial.

In addition, the log will help the service engineer who is usually anxious to co-operate and will welcome the assistance of such a record. Remember that all items need to be recorded, power-driven food preparation machines, refrigerator, in fact any equipment that needs servicing or methodical cleaning.

The daily cleaning

The success of any well-serviced and maintained equipment lies in the initial work that is done by the people who actually use the equipment. The daily, or at least weekly, cleaning of gas burners, top bars, and oven linings, and the daily wipe over with a soft detergent, will keep equipment in almost showroom condition. When one walks into a kitchen and finds equipment up to this high standard, the cooking can usually be assessed at the same level. Chromium-plated café boilers need careful treatment in cleaning, and it is never advisable to use anything stronger than a soap or mild detergent to maintain the finish. Perhaps more important than anything else is the daily cleaning of the coffee and milk urns; it is usual for a special brush to be supplied that allows the draw-off taps to be cleared of any dried milk or coffee which, if left, can go sour and cause all sorts of 'tummy' upsets.

Senior staff responsibility

Above all, it is the responsibility of the senior members of the staff to observe the performance of each and every appliance. Ovens that get over heated, deep fat frying pans that give off smoke at maintenance rate, water boilers that take an unduly long time to fill tea-pots, gas flames that look ill-shaped, are all common, and should be reported and put right on the spot; one should not wait until the routine service call before giving attention.

Finally, for every appliance you have in the kitchen, there should be a servicing manual, leaflet or card kept in a convenient but safe place so that there is little fear of harm being done if non-expert attention has to be given.

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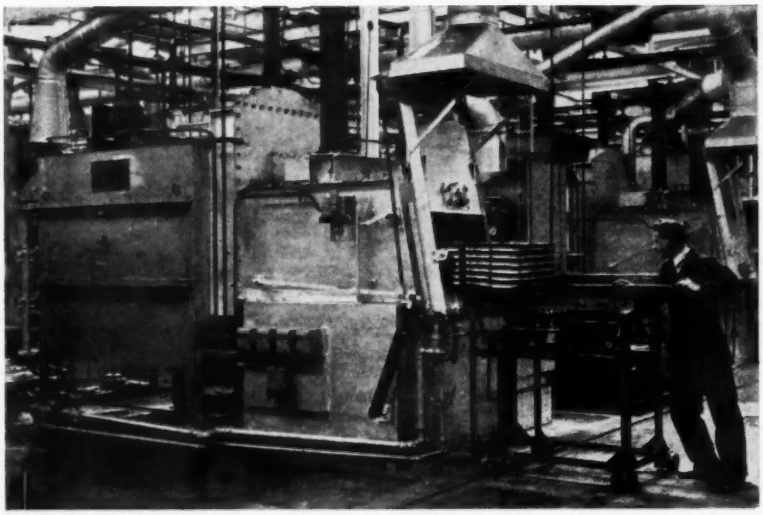

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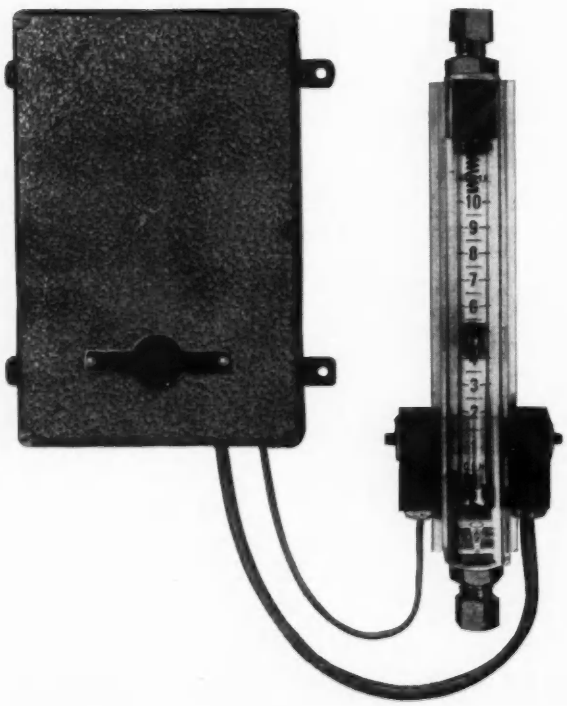

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